

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions and listings of claims in the application:

Claim 1 (currently amended): A filament winding apparatus for winding ~~[[a]]~~ at least two fiber bundles onto a structure, comprising:

a fiber bundle application section, wherein the fiber bundle application section further comprises:

a spool section comprising at least ~~one~~ two fiber bundle spools; and

a winding head comprising at least two winding eyes to receive a fiber bundle from one of the at least two fiber bundle spools, wherein the at least two winding eyes are oriented such that each fiber bundle exits a winding eye in substantially the same plane as each other fiber bundle and at a specified distance from each other fiber bundle; and

a spreading assembly, wherein the spreading assembly comprises at least two curved rods to spread each fiber bundle ~~entering the winding head~~ exiting each winding eye, wherein the winding eyes and curved rods are oriented such that as the fiber bundles spread, the distance between the fiber bundles decreases forming a substantially continuous band of fiber bundles;

a transport to move the fiber bundle application section; and

a controller for applying the ~~fiber bundle~~ substantially continuous band of fiber bundles on the structure.

Claim 2 (original): The filament winding apparatus of claim 1, further comprising a mandrel supporting the structure.

Claim 3 (currently amended): The filament winding apparatus of claim 1, wherein the spool section further comprises:

an idler rod to control the tension in at least one of the at least two fiber bundles.

Claim 4 (original): The filament winding apparatus of claim 1, wherein the spool section further comprises:

an articulator to rotate the spool section.

Claim 5 (original): The filament winding apparatus of claim 1, wherein the fiber bundle application section further comprises:

a winding head rotator to rotate the winding head.

Claim 6 (canceled)

Claim 7 (currently amended): The filament winding apparatus of claim 1, wherein the winding head further comprises:

~~a frame having a top and bottom;~~

~~at least one winding eye disposed on the top of the frame; and~~

a roller to apply the substantially continuous band of fiber bundles on the structure.

~~disposed on the bottom of the frame.~~

Claim 8 (canceled)

Claim 9 (canceled)

Claim 10 (previously presented): The filament winding apparatus of claim 1, wherein at least one of the rods rotates.

Claim 11 (currently amended): The filament winding apparatus of claim 1, further comprising a resin applicator to apply resin to the at least two fiber bundles.

Claim 12 (original): The filament winding apparatus of claim 11, wherein the resin applicator further comprises:

- a resin container;
- a resin hose connected to the resin container; and
- a resin dispenser.

Claim 13 (original): The filament winding apparatus of claim 12, wherein the resin container is heated.

Claim 14 (original): The filament winding apparatus of claim 12, wherein the resin applicator further comprises a resin metering drum to instruct the resin container to provide a measured quantity of the resin to the resin dispenser.

Claim 15 (currently amended): The filament winding apparatus of claim 1, wherein the controller moves the transport to apply the substantially continuous band of fiber bundles on the structure in a predetermined location.

Claim 16 (currently amended): The filament winding apparatus of claim 2, wherein the controller moves the transport and rotates the mandrel to apply the substantially continuous band of fiber bundles on the structure in a predetermined location.

Claim 17 (currently amended): The filament winding apparatus of claim 4, wherein the controller moves the transport and operates the articulator to apply the substantially continuous band of fiber bundles on the structure in a predetermined location.

Claim 18 (currently amended): The filament winding apparatus of claim 5, wherein the controller moves the transport and operates the winding head rotator to apply the substantially continuous band of fiber bundles on the structure in a predetermined location.

Claim 19 (original): The filament winding apparatus of claim 1, wherein the structure is a fuselage for an aircraft.

Claim 20 (original): The filament winding apparatus of claim 1, wherein the fiber bundle has a gauge tow of less than 0.0038 inches.

Claim 21 (currently amended): A filament winding apparatus for winding ~~[[a]]~~ at least two fiber bundles onto a structure, wherein the structure is supported by a mandrel, comprising:

a fiber bundle application section, wherein the fiber bundle application section further comprises:

a spool section, wherein the spool section further comprises:

at least ~~one~~ two fiber bundle spools; and

~~[[an]]~~ at least two idler rods to control the tension in each of the at least two fiber bundles;

an articulator to rotate the spool section; and

a winding head comprising at least two winding eyes to receive a fiber bundle from one of the at least two fiber bundle spools, wherein the at least two winding eyes are oriented such that each fiber bundle exits a winding eye in substantially the same plane as each other fiber bundle and at a specified distance from each other fiber bundle; and

a spreading assembly, wherein the spreading assembly comprises at least two curved rods to spread each fiber bundle ~~entering the winding head~~ exiting each winding eye, wherein the winding eyes and curved rods are oriented such that as the fiber bundles spread, the distance between the fiber bundles decreases forming a substantially continuous band of fiber bundles;

a resin applicator to apply resin to the at least two fiber bundles;
a transport to move the fiber bundle application section; and
a controller for applying the substantially continuous band of fiber bundles on the structure.

Claim 22 (original): The filament winding apparatus of claim 21, wherein the fiber bundle application section further comprises:

a winding head rotator to rotate the winding head.

Claim 23 (canceled)

Claim 24 (currently amended): The filament winding apparatus of claim 22, wherein the winding head further comprises:

~~a frame having a top and bottom;~~
~~at least one winding eye disposed on the top of the frame; and~~
a roller to apply the substantially continuous band of fiber bundles on the structure.
~~disposed on the bottom of the frame.~~

Claim 25 (canceled)

Claim 26 (canceled)

Claim 27 (previously presented): The filament winding apparatus of claim 21, wherein at least one of the rods rotates.

Claim 28 (original): The filament winding apparatus of claim 21, wherein the resin applicator further comprises:

a resin container;
a resin hose connected to the resin container; and
a resin dispenser.

Claim 29 (previously presented): The filament winding apparatus of claim 28, wherein the resin container is heated.

Claim 30 (original): The filament winding apparatus of claim 28, wherein the resin applicator further comprises a resin metering drum to instruct the resin container to provide a measured quantity of the resin to the resin dispenser.

Claim 31 (currently amended): The filament winding apparatus of claim 21, wherein the controller moves the transport, rotates the mandrel, operates the articulator, and operates the winding head rotator to apply the substantially continuous band of fiber bundles on the structure in a predetermined location.

Claim 32 (original): The filament winding apparatus of claim 21, wherein the structure is a fuselage for an aircraft.

Claim 33 (original): The filament winding apparatus of claim 21, wherein the fiber bundle has a gauge tow of less than 0.0038 inches.

Claim 34 (withdrawn): An articulating winding head, comprising:

- a frame having a top and bottom;

- a plurality of spaced apart winding eyes disposed adjacent the top of the frame;

- a plurality of rods arranged within the frame;

- a roller disposed adjacent the bottom of the frame, the winding eyes, rods, and roller being arranged to spread a plurality of fiber bundles entering the winding head and to arrange the spread fiber bundles in side-by-side parallel manner for application to an object to be wound with fiber bundles.

Claim 35 (withdrawn): The articulating winding head of claim 34, wherein at least one of the rods is curved.

Claim 36 (withdrawn): The articulating winding head of claim 34, wherein at least one of the rods rotates.

Claim 37 (withdrawn): The articulating winding head of claim 34, wherein there are three rods.

Claim 38 (withdrawn): The articulating winding head of claim 37, wherein at least one of the rods is curved.

Claim 39 (withdrawn): A method of filament winding a closed-shape structure, comprising:

providing a mandrel on which a fiber bundle can be wound;

providing at least one spool of a fiber bundle for a winding assembly configured to travel along a path substantially parallel to the axis of rotation of the mandrel;

feeding a fiber bundle from the spool through a winding eye;

conveying the fiber bundle through a rod assembly to spread the fiber bundle to a desired thickness; and

applying the fiber bundle to the mandrel.

Claim 40 (withdrawn): The method of claim 39, further comprising:

applying resin to the fiber bundle in an area within the rod assembly.

Claim 41 (withdrawn): The method of claim 39, wherein the rod assembly includes at least one straight non-rotating rod and at least one curved non-rotating rod, the fiber bundle traversing a path from the straight rod to the curved rod.

Claim 42 (withdrawn): The method of claim 39, wherein the fiber bundle is applied to the mandrel in a manner that provides a substantially uniform skin thickness.

Claim 43 (withdrawn): The method of claim 39, wherein applying further comprises:

applying the fiber bundle in a non-geodesic winding path.

Claim 44 (withdrawn): The method of claim 39, wherein applying further comprises:

dividing the mandrel into at least two sections; and

applying the fiber bundle in a non-geodesic winding path within each section.

Claim 45 (withdrawn): The method of claim 39, wherein applying further comprises:

applying the fiber bundle in a non-geodesic winding path on a portion of the mandrel;

and

applying the fiber bundle in a non-geodesic natural winding path on the remaining

portion of the mandrel.

Claim 46 (withdrawn): The method of claim 39, wherein the mandrel is a fuselage for an aircraft.

Claim 47 (withdrawn): The method of claim 39, wherein the fiber bundle has a gauge tow of less than 0.0038 inches.

Claim 48 (currently amended): A system for filament winding a closed-shape structure, comprising:

a first providing component configured to provide a mandrel on which a fiber bundle can be wound;

a second providing component configured to provide at least ~~one~~ two spools of ~~[[a]]~~ fiber bundles for a winding assembly configured to travel along a path substantially parallel to the axis of rotation of the mandrel;

a feeding component comprising at least two winding eyes configured to feed each fiber bundle from the spool through one of the at least two ~~[[a]]~~ winding eyes, wherein the at least two winding eyes are oriented such that each fiber bundle exits a winding eye in substantially the same plane as each other fiber bundle and at a specified distance from each other fiber bundle;

a conveying component configured to convey ~~the~~ each fiber bundle through a rod assembly to spread ~~the tow~~ each fiber bundle to a desired thickness, wherein the rod assembly comprises at least two curved rods to spread each fiber bundle and wherein the winding eyes and curved rods are oriented such that as the fiber bundles spread, the distance between the fiber bundles decreases forming a substantially continuous band of fiber bundles; and

a first applying component configured to apply the substantially continuous band of fiber bundles to the mandrel.

Claim 49 (currently amended): The system of claim 48, further comprising: a second applying component configured to apply resin to the at least two fiber bundles in an area within the rod assembly.

Claim 50 (canceled)

Claim 51 (currently amended): The system of claim 48, wherein the first applying component is configured to apply the substantially continuous band of fiber bundles to the mandrel in a manner that provides a substantially uniform skin thickness.

Claim 52 (currently amended): The system of claim 48, wherein the first applying component is further configured to apply the substantially continuous band of fiber bundles in a non-geodesic winding path.

Claim 53 (currently amended): The system of claim 48, wherein the first applying component is further configured to divide the mandrel into at least two sections; and apply the substantially continuous band of fiber bundles in a non-geodesic winding path within each section.

Claim 54 (currently amended): The system of claim 48, wherein the first applying component is further configured to apply the substantially continuous band of fiber bundles in a non-geodesic

winding path on a portion of the mandrel and to apply the substantially continuous band of fiber bundles in a non-geodesic natural winding path on the remaining portion of the mandrel.

Claim 55 (original): The system of claim 48, wherein the mandrel is a fuselage for an aircraft.

Claim 56 (currently amended): The system of claim 48, wherein the substantially continuous band of fiber bundles has a gauge tow of less than 0.0038 inches.

Claim 57 (withdrawn): A computer readable medium containing instructions for controlling a computer system to perform a method of filament winding a closed-shape structure, the method comprising:

- providing a mandrel on which a fiber bundle can be wound;
- providing at least one spool of a fiber bundle for a winding assembly configured to travel along a path substantially parallel to the axis of rotation of the mandrel;
- feeding a fiber bundle from the spool through a winding eye;
- conveying the fiber bundle through a rod assembly to spread the fiber bundle to a desired thickness; and
- applying the fiber bundle to the mandrel.

Claim 58 (currently amended): A system for filament winding a closed-shape structure, comprising:

- first providing means for providing a mandrel on which ~~[[a]]~~ at least two fiber bundles can be wound;
- second providing means for providing at least ~~one~~ two spools of a fiber bundle for a winding assembly configured to travel along a path substantially parallel to the axis of rotation of the mandrel;

a feeding means comprising at least two winding eyes for feeding ~~[[a]]~~ each fiber bundle from the spool through one of the at least two ~~[[a]]~~ winding eyes wherein the at least two winding eyes are oriented such that each fiber bundle exits a winding eye in substantially the same plane as each other fiber bundle and at a specified distance from each other fiber bundle;

a conveying means for conveying ~~the~~ each fiber bundle through a rod assembly to spread the each fiber bundle to a desired thickness, wherein the rod assembly comprises at least two curved rods to spread each fiber bundle and wherein the winding eyes and curved rods are oriented such that as the fiber bundles spread, the distance between the fiber bundles decreases forming a substantially continuous band of fiber bundles; and

an applying means for applying the substantially continuous band of fiber bundles to the mandrel.

Claim 59 (new): The filament winding apparatus of claim 1, wherein the winding eyes include ceramic inserts.

Claim 60 (new): The filament winding apparatus of claim 1, wherein the spreading assembly further comprises a non-curved rod and wherein the winding eyes, curved rods, and non-curved rod are oriented such that as the fiber bundles spread, the distance between the fiber bundles decreases forming a substantially continuous band of fiber bundles.